Clinical Characteristics of Chemical Sensitivity: An Illustrative Case History of Asthma and MCS

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A case history of the induction of asthma and chemical sensitivity in a 42-year-old registered nurse illustrates several of the characteristic features of multiple chemical sensitivity (MCS). This patient's problems started shortly after moving into a new home under construction, with associated chemical exposures. Other MCS patients report the onset of the condition with other chemical exposures such as those encountered at their places of work or use of pesticides at their residences. Patients often describe a spreading phenomenon of increasing intolerance to commonly encountered chemicals at concentrations well tolerated by other people. Symptoms usually wax and wane with exposures, and are more likely to occur in patients or families with preexisting histories of migraine or with classical allergies. Idiosyncratic medication reactions (especially to preservative chemicals) are common in MCS patients, as are dysautonomia symptoms (such as vascular instability) and poor temperature regulation. Myalgia and joint pains and food intolerance are common features as well. Contamination with xenobiotic chemicals is frequently found in these patients when they are tested. Reactive airways dysfunction syndrome is a recently identified condition that exhibits features of both asthma and chemical sensitivity. MCS patients frequently have patterns of neurotoxic brain metabolism that can be confirmed on single photo emission computed tomography imaging. — Environ Health Perspect 105(Suppl 2):437–441 (1997)

Key words: allergy, asthma, bronchospasm, hypersensitivity, multiple chemical sensitivity, reactive airways dysfunction syndrome, solvent exposure

Introduction

The characteristic clinical features of chemical sensitivity, which includes such factors as demographic data, frequency of symptoms, and theories of pathogenesis, have been described by several authors (*1–8*). However, an illustrative case presentation that demonstrates many of the features of chemical sensitivity can put such demographic and epidemiological data into a useful clinical setting. The case that follows exhibits many of the characteristic features of the clinical course of chemical sensitivity.

A Case History

Presenting Problems

Mrs. M.V. was a 42-year-old registered nurse who, when first seen by the author, had been an inpatient in a tertiary care hospital from May until November 1991. She had been diagnosed with intractable asthma and laryngeal stridor, and was receiving continuous intravenous infusion of epinephrine through a subclavian central venous line. Ingestion of any food or contact with many commonly encountered chemical odors triggered laryngeal stridor and increased wheezing. These symptoms could only be controlled with the iv epinephrine and pushes of Benadryl (Parke-Davis, Morris Plains, NJ) and occasionally, Solu-Cortef (Upjohn, Kalamazoo, MI).

History of Presenting Illness

The nurse's presenting history listed her as last being in reasonably good health in the spring of 1976. A year before she had a left first rib resection for a thoracic outlet syndrome and recovered very well. Shortly after the surgery, however, she moved with her family into an unfinished cedar home, where they lived while construction continued. As the interior construction proceeded, she was exposed to dust, fumes, paint, varnish, unfinished plywood floors, primers, carpeting, sheet rock, and many other construction glues and chemicals. She reported no significant symptoms or intolerance of these exposures at that time.

Two months after the start of this exposure, she had the right first rib resection, and immediately after the surgery she experienced a postoperative hemorrhage. A mediastinal hematoma caused a tracheal shift, and she had the onset of asthma for the first time. She was given iv aminophylline and Solu-Cortef, which helped to control her bronchospasm. However, 3 hr later, significant stridor began. When she was given more steroids in an effort to control these symptoms, she developed a psychosis and the picture of an organic brain syndrome. As the patient continued to recover from the surgery, she developed a recurring pattern of bronchospasm with wheezing, stridor, and tracheal infections. This progressed to intolerance of many medications and other products, especially those containing preservatives like benzyl alcohol, which induced severe asthma.

Over the next few months, the patient reported that many different kinds of chemical exposures triggered irritability, weakness, severe stridor, wheezing, and respiratory distress. Such chemical hypersensitivity had not been noted previously.

The nurse continued to experience increasing chemical reactivity and symptoms began to appear on exposure to a wide variety of common chemicals in concentrations found in everyday settings that were well tolerated by other individuals. The symptoms waxed and waned with exposures. She often reacted with bronchospasm or stridor to the undetected presence of chemicals (e.g., propane gas for cooking in a restaurant), or she detected and reported chemical odors long before other people became aware of them. The major effects of these exposures were bronchial hypersensitivity, wheezing, stridor, and dysphonia, all of which could be triggered on exposures to chemical substances such as perfume, phenol, disinfectants, wintergreen, new carpeting, natural gas, formaldehyde, lipsticks, and many others. The patient developed a pattern of intractable and severe wheezing. The only therapeutic intervention that consistently controlled her symptoms was iv infusion of epinephrine. After bronchospasm was induced, she was often in the hospital for weeks or months.

Past Health

The nurse's past health was marked by a 2-month cough in 1963 that a physician

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Abbreviations used: MCS, multiple chemical sensitivity.

thought was an allergic reaction. In 1979, approximately 4 years after the induction of the asthma and stridor, skin-prick testing was performed by an allergist to determine the extent and severity of allergies that might be triggering wheezing and stridor. When given a desensitization treatment injection containing a phenol preservative, the patient developed severe asthma, went into shock, and was hospitalized for a week. When the treatment solution was diluted by a factor of 10, and injections restarted at one lower concentration, the third therapeutic injection in the new series resulted in a hospital admission for 2 weeks with similar symptoms.

In 1979, the patient was referred to a nationally known clinic where skin testing was again attempted; this induced significant bronchospasm and respiratory distress. The patient was treated with iv steroids, after which she again became very agitated and irrational. During this time she was told that her problems were mostly psychiatric and that she was neurotic. On one occasion during an episode of significant laryngeal irritation and stridor, the patient was asked to bend over, upon which she lost consciousness, became cyanotic, and had to have a face mask applied. In 1981 she developed right-sided hyperesthesia and for 2 weeks, slight rotary nystagmus. She was diagnosed with possible multiple sclerosis, although the symptoms later disappeared. In 1982 she experienced severe stridor induced by benzyl alcohol preservative in a heparin lock flush being used in a central venous line. The patient went on to develop a pattern of recurrent laryngeal infections, especially in the spring and fall, usually attributable to Hemophilus influenza. These infections almost invariably progressed to significant bronchospasm, wheezing, and stridor, resulting in hospitalization for 3 to 4 weeks at a time. At this time she was placed on Rifampin on a full-time basis as prophylaxis for these infections.

Systems Review

On systems review, some of the patient's key problems were that of easy bruising, migraine headaches, especially when she took birth control pills, indigestion with bloating and flatulence from ingestion of certain foods, cold hands and feet, arthritic-like knee and other joint pains, recurrent vaginal yeast infections, difficulty of swallowing in the presence of the stridor, confirmed hypoglycemia, abdominal pain with the ingestion of sulfite-containing foods, and significant wheezing and stridor upon ingesting monosodium glutamate. Smoke from burning wood, which was very prevalent in the area where she lived, always induced wheezing.

Social and Family History

The patient, a registered nurse, when first evaluated had been disabled for 10 years because of persistent life-threatening asthma and widespread chemical sensitivities. She was married and had two children. She had no history of psychiatric medications or admissions. Her family history revealed that her mother had lifelong eczema and was troubled with arthritis and head stuffiness. Her father died of respiratory failure and had lead poisoning from working with lead-based paints, while painting railway cars. She had five brothers, the oldest of whom had asthma, and his children had asthma. A sister's children also had asthma. A son has asthma and food allergies, and a daughter has asthma and food allergies and was on desensitization shots. The patient's medications at the time of initial evaluation were epinephrine iv infusion, Solu-Cortef (approximately once per month), iv Benadryl (25–50 mg every 3–4 hr as needed for allergic symptoms), Rifampin, oral sodium cromolyn, Seldane, Tagamet, and Pulmicort.

Environmental History

The patient's pertinent environmental history revealed she was living in a cedar home that frequently was pervaded by the aromatic smell of wood terpene. The home was insulated with fiberglass and was purposely built to be tight and energy efficient. There was a deep artesian well. Weed control herbicides were used yearly on the lawn, and insecticide powder was used in the basement. Mold grew around the windows, where water condensation frequently occurred. The bedroom in which she slept had unfinished plywood floors.

Physical Exam

The physical exam revealed vital signs of temperature 97.8, pulse 80, respiration 16, and blood pressure 110/60. The patient had evidence of pharyngitis and allergiclike rhinitis; she had 11 silver amalgam fillings in her teeth. There was no wheezing when she was initially examined while receiving an iv drip of epinephrine. Otherwise, the physical examination appeared within normal limits.

Laboratory Investigation

Results of a laboratory investigation of the possibility of chemical contamination are shown in Table 1. These analyses were performed by AccuChem Labs (Richardson, TX) using the gas chromatography–mass spectroscopy methodology cited by the Centers for Disease Control and Prevention as the most accurate available (*9*). It should be noted that the patient's level of toluene, for example, was 10 times less than the U.S. population mean of 0.52 ppb (*9*). The patient's serum IgE was 175 on a scale of 1 to 180.

Table 1. Blood xenobiotic contaminants.

Chemical	Value, ppb	Laboratory mean, ppb
Toluene	5.2	2.1
Trimethylbenzenes	1.4	<1.0
1,1,1-Trichloroethane	1.1	<1.0
2-Methylpentane	20.7	9.6
3-Methylpentane	48.0	17.4
n-Hexane	17.7	8.3

Data from Ashley et al. (*9*).

Discussion

This patient's presentation illustrates several features that are commonly seen in chemically sensitive patients. There often is a preexisting or concurrent history of allergic disease in the patient and/or the patient's family. Similarly, a tendency toward migraine or dysautonomia symptoms (e.g., cold hands and feet and difficulty with temperature regulation) is frequently present. This patient exhibited the spreading phenomenon (*2,3*), whereby she became increasingly sensitive to a wider and wider variety of structurally unrelated chemical substances once the process of chemical sensitivity was initiated.

Mrs. M.V. also had two frequently reported initiating factors that have been described by chemically sensitive patients as triggering events in the induction of their problems (*1*). Figure 1 shows the results of a survey of 200 chemically sensitive patients at the Environmental Health Center–Dallas, Dallas, Texas. The most frequently reported trigger was a newly constructed home or a job site where occupants or workers were extensively exposed to construction materials such as paints, solvents, carpet, etc. These types of new home or job site renovations account for 30% of the triggers of MCS cited by 200 patients at the Environmental Health Center–Dallas (Figure 1). Other types of chemical exposures (e.g., pesticides) account for another 24%. Miller and Mitzel (*10*) reported on groups of chemically sensitive patients who cited remodeling or pesticide applications

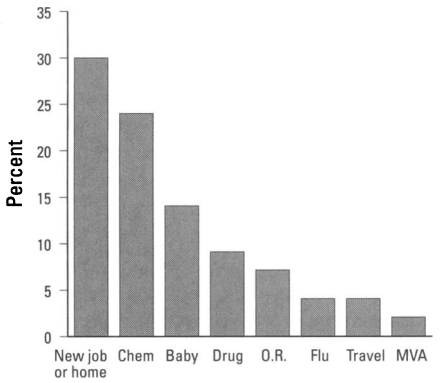

Figure 1. Suspected triggers of MCS in 200 chemically sensitive patients in studies conducted at the Environmental Health Center–Dallas, Dallas, Texas. Abbreviations: chem, chemicals; O.R., operation with anesthesia; MVA, motor vehicle accident.

as initiating events. While their symptomatology was similar, the pesticide-exposed group reported more severe symptoms, as would be expected because of the greater neurotoxicity of that group of chemicals. It was felt that this finding provided evidence for a possible biological basis for chemical sensitivity, with a common pathophysiological induction pathway of MCS between these two groups of exposed patients.

The patient in this case also was administered anesthetic during surgery and experienced a postoperative hemorrhage. Surgeries with anesthetics are cited as triggers of MCS by 7% of 200 MCS patients (Figure 1). It has been the experience of the author that the induction of a vasculitislike syndrome with blood vessel fragility and easy bleeding is commonly seen in chemically exposed patients, whether or not they report chemical sensitivity (*11–13*).

Mrs. M.V. also exhibited the joint pains and food intolerances with gas and bloating so often seen in chemically sensitive patients (*1*). Vasospastic phenomena and dysautonomia are also frequently noted in these patients (*14,15*) and these symptoms correlate with the vasospastic phenomena seen in odor- and food-induced migraine (*16*). It is of interest that the patient had a psychotic and agitated response to steroids, which is similar to the neurocognitive or emotional instability reported by MCS patients at times in response to chemical exposures. Some authors have ascribed such symptoms in chemically sensitive patients to psychiatric diagnoses (*17–19*), but the validity of these conclusions has been seriously questioned in a recent critical review (*5*). Moreover, an animal model has been recognized that can explain many of the features of such an illness on a physiological basis of time-dependent sensitization and limbic kindling or other neurological sensitization (*7,20–23*). Bell and colleagues have reported a role for organic factors contributing to the poor health in patients with cacosmia, one of the features characterizing chemical sensitivity (*24*). In our experience, the incidence of significant psychiatric disease as a major causative factor in MCS is very low, probably less than 2 or 3%.

Findings of neurotoxic patterns on cerebral metabolism after chemical exposures (*25*) lend credence to the organic origin of the neurocognitive complaints of poor memory and concentration frequently reported by MCS patients. Callender has shown the effectiveness of brain metabolic single photo emission-computed tomography scans in following the objective chronic central nervous system effects subsequent to an acute insecticide exposure (*26*); Simon has found evidence for neurotoxic effects on cerebral metabolism in chemically exposed and chemically sensitive patients (*27*).

Legitimate criticisms can be raised about the validity and reproducibility of these scans and about whether the behavioral state of the patient will influence the results (*28*). Simon and colleagues make use of a strictly standardized protocol, mental status evaluation, and visual imagery during this procedure (*29*).

Finally, this patient had substantial chemical contamination with xenobiotics at levels that were significantly higher than the mean from the reference laboratory. Indeed, her blood levels of toluene and 1,1,1-trichloroethane, for example, were well above the 95th percentile when compared to values found in nonoccupationally exposed persons in the United States using the same methodology (*9*). Chemical contamination is an important issue, and one that generates disagreement and different points of view. Critics argue that the levels of potentially toxic xenobiotics found in many patients who claim chemical sensitivity are meaningless and thus not clinically relevant from a toxicological point of view (*30*). Others contend that these substances are foreign to the body and that the ordinary dose–response curve assumptions may not apply for low levels of these toxic xenobiotics. Indeed, there is evidence that low levels of mixtures of genotoxic chemicals (including benzene) may actually be more damaging than higher levels because they do not trigger an appropriate induction of detoxification enzymes (*31*). In addition, there is evidence that the synergistic effect of multiple low levels of potentially toxic xenobiotics may be clinically relevant, as appears to be the case in chemically exposed Gulf War veterans (*32*). This finding is consistent with the fact that many chemically sensitive, chemically contaminated patients appear to have impaired detoxification abilities (*33,34*).

The patient had symptoms that waxed and waned on exposure; these symptoms were much more likely to occur if she also developed an infection. This illustrates the principle of the total load, which can be applied to all patients (*3*). Once the total load exceeds a certain threshold, a patient's adaptive mechanisms seem no longer capable of maintaining homeostasis (*3,35*). This patient later developed a pattern of bronchospasm induced by chemical exposures that might be classified as reactive airways dysfunction syndrome (*36,37*).

Treatment

At the request of Mrs. M.V.'s attending consultant, she was air transported 2500 miles, escorted by a physician, to the Environmental Control Unit at Tri-City Hospital in Dallas. This specialized hospital wing is constructed of less polluting construction materials and has a highly filtered air system. Organically grown food, bottled water, and specialized procedures are employed to minimize indoor air pollutants. This creates a safe environment for the stabilization, investigation, and treatment of chemically sensitive patients (*38,39*).

Within 36 hr of entering the filtered atmosphere of this unit, the patient's wheezing resolved and all her medications were stopped. She fasted for 4 days, drank only bottled spring water, and then started on a monorotational diet of organically grown foods. Some foods were found to trigger her wheezing and stridor, whereas others did not.

The patient was found to be extremely sensitive to the sulfite preservative in epinephrine, which was confirmed by intradermal testing. Pure, sulfite-free epinephrine was obtained and was used either iv or by sc injection to abort her bronchospasm and wheezing with excellent results. Previously, if these symptoms were induced, the patient knew by experience that she would wheeze and be in distress for weeks to months at a time.

A comprehensive treatment program was developed (*40*) that included avoiding chemical triggers, eating a rotational diet of organically grown foods, administration of immunotherapy antigens to reduce

the extent and severity of allergies and sensitivities, environmental cleanup at home (using less toxic materials), and specific nutritional support to enhance detoxification ability to supply antioxidant nutrients.

The patient made significant improvement on this regimen. After 10 years of disability, she was able to resume her nursing career, and over the next 3 years she remained much more stabilized. She continued to exhibit chemical sensitivity, including episodes of wheezing and stridor triggered by certain exposures, but these could usually be aborted by a single injection or two of sc pure epinephrine. Antihistamines, bronchodilators, and steroids were almost useless in this patient's case. Over the next 3 years, she had only a few brief hospital stays, whereas previously she had been in the hospital for weeks or months at a time.

Some recent outcome studies (*41–44*) have shown evidence of the efficacy of such comprehensive treatment programs for polysymptomatic patients who report chemical sensitivity. Maberly and colleagues have found positive results in the treatment of asthma in the controlled atmosphere and surroundings of the Environmental Control Unit, clearly demonstrating the adverse effect of certain foods and chemicals on the peak flow rate (*41*). They also found successful and significant reduction of symptoms and medication use after treatment involving dietary modification and subcutaneous immunotherapy antigens to alleviate complex allergy and sensitivities (*42*).

Maberly and colleagues also cited evidence of beneficial outcomes in polysymptomatic patients using a comprehensive environmental medicine approach (*43*) including the types of interventions discussed in this case history.

Maberly's experience parallels the improvement in symptoms reported by chemically sensitive and polysymptomatic patients treated at the Nova Scotia Environmental Medicine Clinic in Halifax, Canada, a government-sponsored project.

In an uncontrolled study of 85 patients reporting chemical sensitivity symptoms, scores were followed by the Nova Scotia Department of Health over 10 months of treatment. In addition to assessing the level of patient satisfaction with the services provided, symptom changes were carefully evaluated using pre- and posttreatment questionnaires. There were statistically significant improvements in the scores for a number of symptoms using comprehensive environmental medicine treatment; these included scores for mental confusion, fatigue, headache, and anxiety (*44*).

The limitations of such unblinded and uncontrolled global outcome measurements are obvious. Nevertheless, such information provides a starting point from which to ask more definitive questions. This pilot clinic has now been superseded by the Nova Scotia Environmental Health Clinic, a medical school-based research and treatment program that is also funded by the government of Nova Scotia. It is hoped that more answers will be forthcoming from well designed clinical trials currently planned and underway.

Although this case presentation involves consideration of classic allergic symptoms in addition to symptoms of MCS, it also illustrates several key features of chemical sensitivity and some of the intervention and treatment approaches that can be very helpful for these patients.

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